SECURIFY

Automated Formal Verification of Smart Contracts


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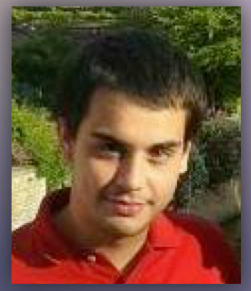
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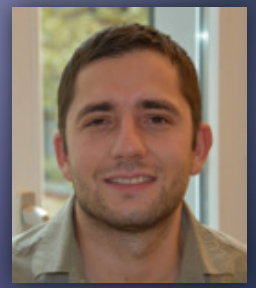
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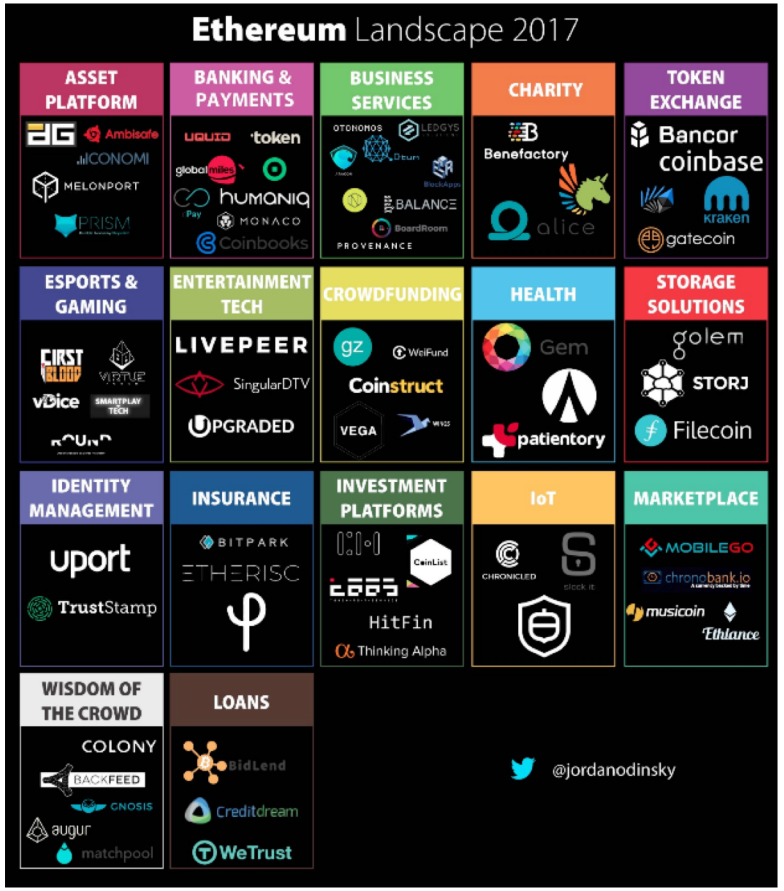
Growth of the Ethereum Ecosystem

Billions of USD are traded by Ethereum smart contracts



Emerging businesses are built on top of Ethereum smart contracts

Smart Contract *Security Bugs* in the News

The DAO Attacked: Code Issue Leads to $60 Million Ether Theft

Jun 17, 2016 at 14:00 UTC by Michael del Castillo

Ethereum • News • Ethereum

in 466

The DAO, the distributed autonomous organization that had collected over $150
ether, has reportedly been hacked, sparking a broad market sell-off.

A leaderless organization comprised of a series of smart contracts written on the
DAO has lost 3.6m ether, which is currently sitting in a separate wallet after being
grou

The DAO Falls Victim to Cyber Attack Leading Ethereum to Crash Over 20%

The event is still ongoing as hackers have already stolen over 3.5 million ETH from the DAO's coffers.

Avi Mizrahi | Trading (CryptoCurrency) | Friday, 17/06/2016|12:45 GMT

Photo: Finance Magnates

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$32 million worth of digital currency ether stolen by hackers

- Around 153,000 ether tokens worth $32.6 million were taken by hackers on Wednesday.

llet was exploited by hackers.
day where $7 million worth of ether

ET Thu, 20 July 2017

Hackers have stolen $32 million in Ethereum in the second heist this week

Smart contract coding company Parity has issued a security alert, warning of a vulnerability in version 1.5 or later of its wallet software.

So far, 150,000 ethers, worth $30 million (£23 million), have been reported by the company as stolen, data confirmed by Etherscan.io.

www.jamesedition.com

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Smart contract coding company Parity yesterday issued a security alert, warning of a vulnerability in version 1.5 or later of its wallet software. According to the company, so far 150,000 ethers have been stolen, worth nearly $35 million at current price levels. The amount of the stolen ether has been confirmed by Etherscan.io.

What are Ethereum Smart Contracts?

```
contract Wallet {
  uint balance = 10;

  function withdraw(){
    if(balance > 0)
      msg.sender.call.value(balance)();
    balance = 0;
} }
```

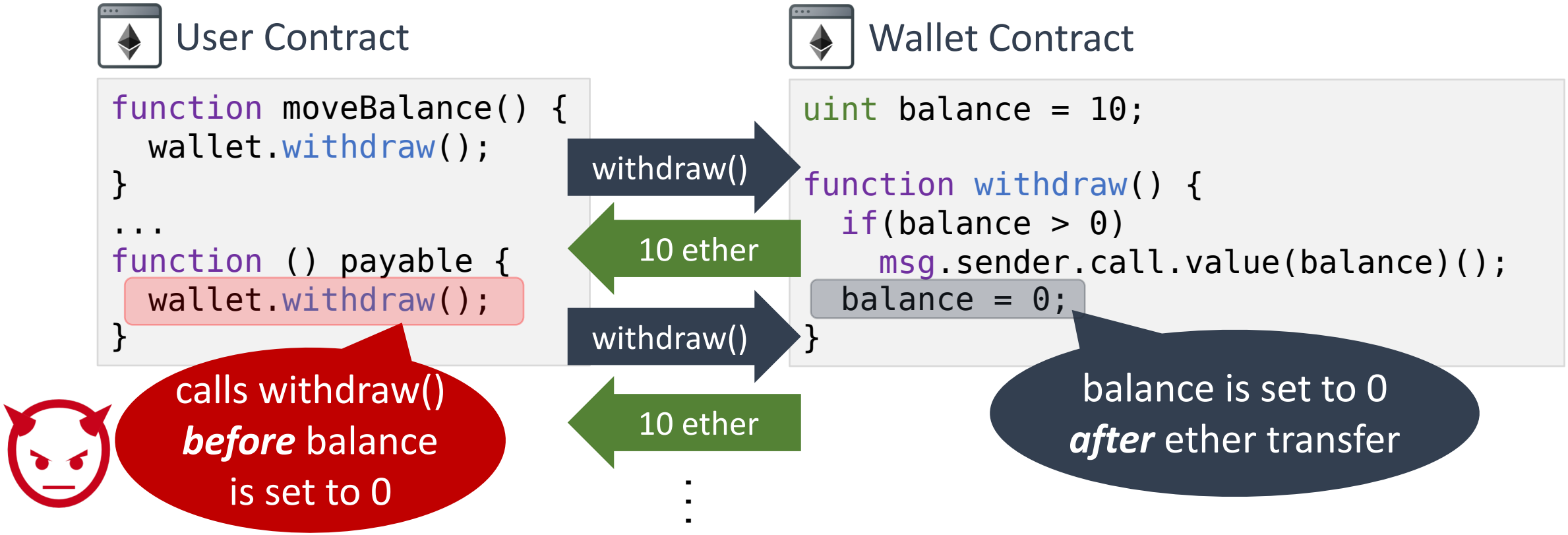
Transfer $$$ to the caller

- Small programs that ***handle money*** (ether)
- Executed on the Ethereum blockchain
- Written in high-level languages (*e.g.*, Solidity)
- ***No patching*** after release

What can go wrong when programs handle billions of USD?

Security Bugs in Ethereum Smart Contracts

Security Bug #1: Reentrancy



An attacker used this bug to steal 3.6M ether (equivalent of ***$1B today***)

Security Bug #2: *Unprivileged* write to storage

Any user may change the wallet's owner

Wallet Contract

```
address owner = ...;

function initWallet(address _owner) {
  owner = _owner;
}

function withdraw(uint amount) {
  if (msg.sender == owner) {
    owner.send(amount);
  }
}
```

Only owner can send ether

An attacker used a similar bug to ***steal $32M*** few weeks ago

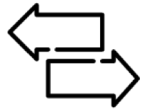
More Security Bugs…

Unexpected ether flows

Insecure coding, such as unprivileged writes *(e.g., Multisig Parity bug)*

Use of unsafe inputs (e.g., reflection, hashing, …)

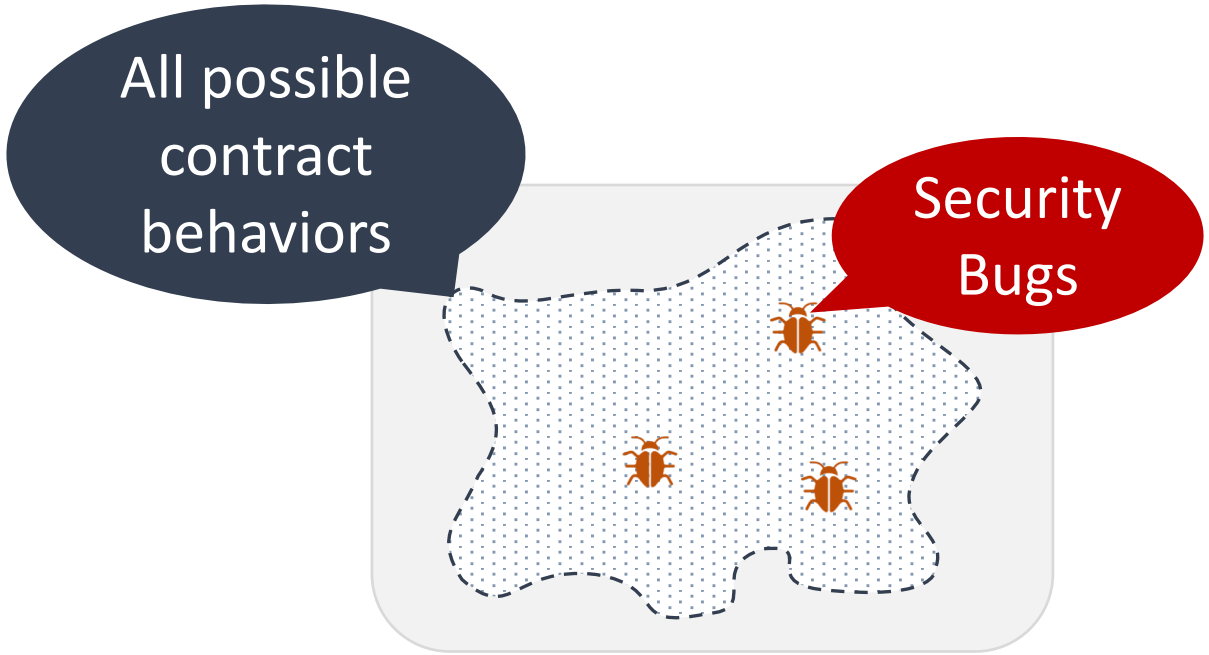
Reentrant method calls *(e.g., DAO bug)*



Transaction reordering

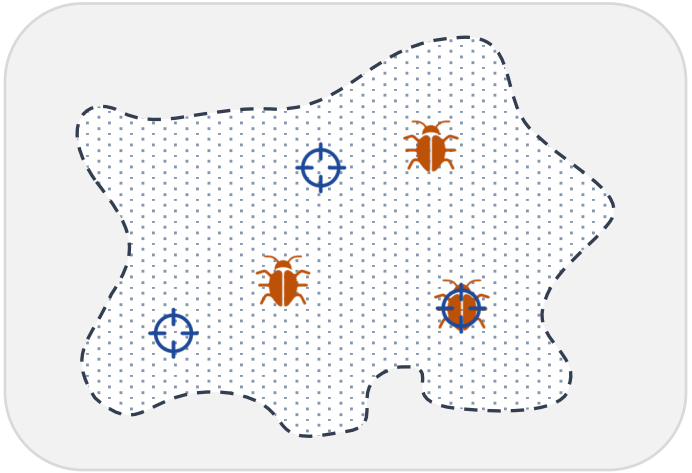

Automated Security Analysis

Automated Security Analysis: Existing Solutions



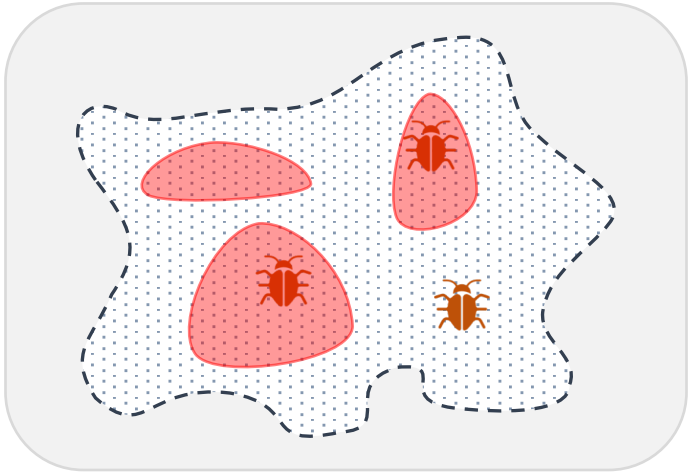
Problem: Cannot enumerate all possible contract behaviors…

Automated Security Analysis: Existing Solutions



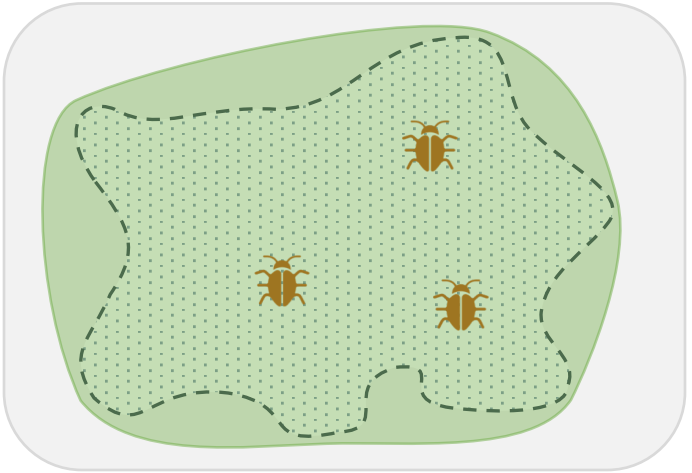
- Testing

Very limited guarantees



- Dynamic analysis
- Symbolic execution

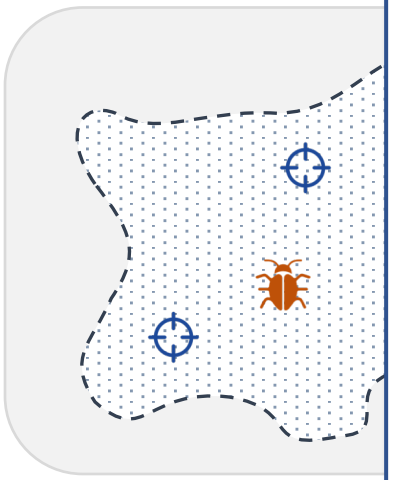
Better than testing, but
can still miss vulnerabilities



- Static analysis
- Formal verification

Strong guarantees

Automated Security Analysis: Existing Solutions

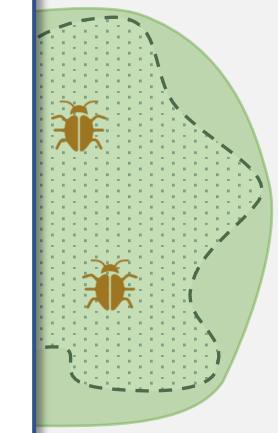


- Testing

Very limited g

Existing Solutions

	Automated	Strong Guarantees
Oyente	✓	✗
ITP-based	✗	✓
SECURIFY	✓	✓



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can still miss vulnerabilities

www.securify.ch

The first fully ***automated***, one-click, ***formal verification system*** for Ethereum smart contracts

Provides ***trust*** towards both contract users and developers


Demo

SECURIFY

www.securify.ch

Released last month, so far:

- 95% positive feedback
- >1K uploaded smart contracts
- >150 users signed up for updates

Interesting discussions on Reddit

[–] **mcgravier** **22 points** 12 days ago

Seems almost too good to be true :) What are the limitations and how exactly does it work under the hood?

It's great that the authors of the tool are aware they are app
set of behaviors in the growing direction. That's the way to
safety properties without false-negatives. I'm interested how they compare their EVM semantics against other EVM implementations in the wild.

[–] **AlexanderSupersloth** **12 points** 12 days ago

Please, someone, humour a layman: how can a Turing complete language be formally verified?

I thought formally verifiable languages were necessarily not Turing complete, and we can therefore not formally verify Solidity.

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